Claims

[c1] 1. A detection system, comprising:

means for performing a test on a semiconductor device and obtaining test data therefrom, wherein the semiconductor device includes an insulating layer, a hard mask layer on a surface of the insulating layer, and a plurality of electrically conductive lines within a trench in the insulating layer, wherein the insulating layer comprises a first dielectric material, wherein the hard mask layer comprises a second dielectric material, wherein the dielectric constant of the second dielectric material exceeds the dielectric constant of the first dielectric material or the second dielectric material comprises an element that is not comprised by the first dielectric material, and wherein the test data is a function of a spatial distribution of the hard mask layer on the surface of the insulating layer; and

means for determining from said test data a measure of said spatial distribution of the hard mask layer on the surface of the insulating layer.

[c2] The detection system of claim 1, wherein said measure provides an indication of a presence or absence of the hard mask layer on a localized portion of the surface of the insulating layer.

[c3] The detection system of claim 2, wherein said means for performing comprises means for directing a photon beam toward the localized portion of the surface of the insulating layer of the semiconductor device resulting in a consequent electron beam comprising said test data returned from the semiconductor device, wherein said means for performing further comprises means for measuring an energy of the electron beam resulting in a measured energy of the electron beam, wherein said test data comprises said measured energy of the electron beam, and wherein said means for determining comprises means for comparing said measured energy of the electron beam with existing calibration data.

[c4] The detection system of claim 1, wherein said measure provides an indication of a thickness of the hard mask layer on a localized portion of the surface of the insulating layer.

[c5] The detection system of claim 4, wherein said means for performing comprises means for directing an electron beam toward the localized portion of the surface of the insulating layer of the semiconductor device resulting in a consequent photon beam returned from the semiconductor device, wherein said means for performing further comprises means for measuring an energy of the photon beam resulting in a measured energy of the photon beam, wherein said test data comprises said measured energy of the photon beam, and

wherein said means for determining comprises means for comparing said measured energy of the photon beam with existing calibration data.

[c6] The detection system of claim 1, wherein said measure provides an indication of a presence or absence of the hard mask layer on the surface of the insulating layer.

[c7] The detection system of claim 1, wherein said measure provides an indication of a thickness distribution of the hard mask layer on the surface of the insulating layer.

[c8] The detection system of claim 7, wherein said means for performing comprises means for measuring a capacitance between a pair of electrically conductive lines of the plurality of electrically conductive lines resulting a measured capacitance between said pair of electrically conductive lines, wherein said test data comprises said measured capacitance, and wherein said means for determining comprises means for comparing said measured capacitance with existing calibration data.

[c9] The detection system of claim 7, wherein said means for performing comprises means for measuring a capacitance between a first electrically conductive line of the plurality of electrically conductive lines electrically coupled to a second electrically conductive line of the plurality of electrically conductive lines and a third electrically conductive line of the

plurality of electrically conductive lines resulting a measured capacitance between said electrically conductive lines, wherein said means for performing further comprises means for measuring a resistance of the third electrically conductive line of the plurality of electrically conductive lines resulting a measured resistance of the third electrically conductive line, wherein said means for performing further comprises means for multiplying the measured capacitance with the measured resistance resulting in a product, wherein said test data comprises said product, and wherein said means for determining comprises means for comparing said product with existing calibration data.

[c10] The detection system of claim 1, wherein the spatial distribution of the hard mask remaining on the surface of the insulating layer is used to determine whether the semiconductor device is to be accepted or rejected.

[c11] 11. A detection method, comprising:
performing a test on a semiconductor device and obtaining test data therefrom, wherein the semiconductor device includes an insulating layer, a hard mask layer on a surface of the insulating layer, and a plurality of electrically conductive lines within a trench in the insulating layer, wherein the insulating layer comprises a first dielectric material, wherein the hard mask layer comprises a second dielectric material,

wherein the dielectric constant of the second dielectric material exceeds the dielectric constant of the first dielectric material or the second dielectric material comprises an element that is not comprised by the first dielectric material, and wherein the test data is a function of a spatial distribution of the hard mask layer on the surface of the insulating layer; and

determining from said test data a measure of said spatial distribution of the hard mask layer on the surface of the insulating layer.

[c12] The detection method of claim 11, wherein said measure provides an indication of a presence or absence of the hard mask layer on a localized portion of the surface of the insulating layer.

[c13] The detection method of claim 12, wherein said performing comprises directing a photon beam toward the localized portion of the surface of the insulating layer of the semiconductor device resulting in a consequent electron beam returned from the semiconductor device, wherein said performing further comprises measuring an energy of the electron beam resulting in a measured energy of the electron beam, wherein said test data comprises said measured energy of the electron beam, and wherein said determining comprises comparing said measured energy of the electron

beam with existing calibration data.

[c14] The detection method of claim 11, wherein said measure provides an indication of a thickness of the hard mask layer on a localized portion of the surface of the insulating layer.

[c15] The detection method of claim 14, wherein said performing comprises directing an electron beam toward the localized portion of the surface of the insulating layer of the semiconductor device resulting in a consequent photon beam returned from the semiconductor device, wherein said performing further comprises measuring an energy of the photon beam resulting in a measured energy of the photon beam, wherein said test data comprises said measured energy of the photon beam, and wherein said determining comprises comparing said measured energy of the photon beam with existing calibration data.

[c16] The detection method of claim 11, wherein said measure provides an indication of a presence or absence of the hard mask layer on the surface of the insulating layer.

[c17] The detection method of claim 11, wherein said measure provides an indication of a thickness distribution of the hard mask layer on the surface of the insulating layer.

[c18] The detection method of claim 17, wherein said performing comprises measuring a capacitance between a pair of

electrically conductive lines of the plurality of electrically conductive lines resulting a measured capacitance between said pair of electrically conductive lines, wherein said test data comprises said measured capacitance, and wherein said determining comprises comparing said measured capacitance with existing calibration data.

[c19] The detection method of claim 17, wherein said performing comprises measuring a capacitance between a first electrically conductive line of the plurality of electrically conductive lines electrically coupled to a second electrically conductive line of the plurality of electrically conductive lines and a third electrically conductive line of the plurality of electrically conductive lines resulting a measured capacitance between said electrically conductive lines, wherein said performing further comprises measuring a resistance of the third electrically conductive line of the plurality of electrically conductive lines resulting a measured resistance of the third electrically conductive line, wherein said performing further comprises means for multiplying the measured capacitance with the measured resistance resulting in a product, wherein said test data comprises said product, and wherein said determining comprises comparing said product with existing calibration data.

[c20] The detection method of claim 11, further comprising using the

spatial distribution of the hard mask remaining on the surface of the insulating layer to determine whether the semiconductor device is to be accepted or rejected.